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Overcoming Roadblocks of Testing Large Capacity Scales

By John Barton

Large amounts of product in bulk form and individual products of considerable mass require the use of scales with large capacities to facilitate transactions where these products must be quantified in terms of weight. Proper testing of these devices can be influenced by a number of factors, but perhaps none more so than the characteristics of their design and installation. NIST Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing Devices, includes several important requirements which are available to scale inspectors whose duties routinely involve difficulties encountered when testing these large capacity scales.

Certain categories of large capacity scales are generally tested without a great deal of difficulty; two that come immediately to mind are vehicle scales and railroad track scales. Performing a proper test of most vehicle-type scales encountered normally presents only minor complications, if any at all. These scale installations generally provide relatively easy access to the weighing element(s) for testing and inspection purposes, as they are designed to accommodate large vehicles which handle the products that are weighed on this type of scale. The load receiving element most often consists of a large, flat surface with little or no obstructions. Mechanized test equipment and an adequate supply of weight standards are commonly available. Railroad track scales normally consist of a narrow section of rail track that makes up the weighing element, and the scales are configured for considerable capacities (commonly 200,000 lb to 500,000 lb). This type of configuration can eliminate the ability of many agencies to provide an official test. This being the case, testing of these railroad track scales are performed by only a limited and exclusive group of agencies having the proper equipment and the availability of sufficient test weights. In many instances these agencies are contracted to furnish test equipment and services, thereby eliminating the burden to regulatory officials of performing the test themselves.

Other categories of large capacity scales do present routine difficulties due to the nature of their design and their prolific utilization. Unfortunately, for the scale inspector, there are many products which are handled in a more efficient manner by the use of scales that are more specialized in their design and construction. These scales are better suited to meet the owner's needs; however, they often involve obstacles that must be circumvented when performing a safe and comprehensive evaluation of their performance.

NIST Handbook 44 provides the inspector with requirements (primarily User Requirements) that place the responsibility of removing the barriers to effective and efficient test procedures on the scale owner and installation technician. Within Handbook 44 there are requirements which address access to weighing elements. For example, Section 2.20, paragraph UR.2.5. - Access to Weighing Elements; and Section 1.10, paragraph G-UR.2.3. - Accessibility for Inspection, Testing, and Sealing Purposes, both convey the need for proper installation of scale components which facilitate the inspection of devices. The requirements of construction and installation, when enforced, will assist the inspector and technician in performing their duties with minimal obstruction. This is also recognized and addressed in requirements such as Section 2.20; paragraph UR.2.9 - Provision for Testing Dynamic Monorail Weighing Systems, and Section 2.20, paragraph UR.2.6. - Approaches. There are applicable requirements that specifically address the responsibility of the owner or operator such as Section G-UR.4.4. – Assistance in Testing Operations. Requirements such as these are often used to facilitate the task of proper scale testing and inspection. However, it should be acknowledged that the resources available and the motivation of owners and operators to supply any necessary assistance can be limited.

NIST Handbook 44 Section 2.20, paragraph N.3., and Table 4 also dictate the minimum test weight and test loads necessary for an official test. Unfortunately, these requirements do not typically require the manufacturer of these large capacity devices to include provisions to properly position test weights on the weighing elements. Scales used to weigh a particular type of product and those built with a specific function within a process are not often designed with the inspection and testing process in mind.

Many regulatory departments, facing a lack of resources, will require each inspector to be proficient in the inspection of all weighing and measuring devices encountered in the field rather than training employees as specialists in different categories of device inspection. This being the case, it may be beyond the scope and ability

of many agencies to equip every employee with a full complement of various standards, and the minimum amount of standards needed to perform an official test on these larger capacity scales.

Provided that sufficient standards are available, the amount and the denomination of the test weights used may necessitate the use of mechanical means to apply the standards to the weighing element. The use of mechanized means to position large test weights during a test provides an alternative to the labor intensive manual methods, although the machinery used to move the weights is not always maneuverable enough to navigate tight spots or close quarters. Personal experience has made it clear to me that design engineers, manufacturers, and installers of large capacity scales have given little thought to the inspection process, which will continue long after the initial set-up of these devices. Livestock scales are installed with the focus being on maintaining control of the animals through the gates, stalls, and the show rings rather than with transporting test equipment and standards to and from the scales. In similar fashion, most above ground hopper-type scale installations are obviously constructed and installed with little regard for the scale inspector's method of testing. The use of machinery to move large test weights on to and off of these large capacity scales may also be restricted due to the location of the scale in a hazardous or a sanitary environment. The need for the use of special equipment also makes it more unlikely that a regulatory official will be prepared to perform an on-the-spot inspection without prior arrangements being made. The performance of unannounced inspections is a core principle in many jurisdictions and a tool used to enforce the laws and requirements the agency is mandated to carry out.

Capacities of 5,000 – 20,000 lb are common with crane, hopper, monorail, and animal scales, and they are most often manufactured with larger capacities and smaller load receiving elements. The inspector is then faced with the task of transporting the standards to the scale. The proper distribution of test weight on the weighing element is critical to obtain valid test results, and the inspector must take care to avoid any situation where off-center loading can occur. Errors resulting from unequal pressure placed on the load bearing points can produce skewed results and serve to invalidate an official test. These devices are constructed to perform accurately when used as designed and, therefore, should be tested using test loads applied to the device in a manner that reproduces the application of force (with regards to stress points and direction of loading) when in use.

Many times innovation is called for when placing standards of sufficient amount and denomination onto the scale. Very few installations are identical, and each situation may have its own peculiarities. Chains, slings, cables, and custom-made riggings may be needed for proper testing, and the use of these must be done in ways that avoid binding, twisting, or any type of interference with the live portions of the scale. It must be understood that the use of these items also adds weight to the device which must be accounted for (consideration of dead load and initial zero setting) during testing. Custom-made devices are, in many instances, expensive, given the specialized nature of their construction, and are possibly used only during a small number of actual tests, thereby calling into question the practicality of investing in such an item. In addition, the use of these means must always precipitate concern for personal safety and for possible damage of the scale itself. Substitution, strain, and materials testing are methods which provide the inspector with alternatives.

Materials testing uses product commonly weighed during normal use of the scale as a test load. This material is weighed elsewhere either prior to or after being weighed on the scale under evaluation (hopefully within a short time frame so as to minimize any change to either the material's weight or the scale's performance). Therefore, this method relies on the availability of a certified reference scale which may or may not be in the vicinity. Due to the nature of the procedure involved and the involvement of uncontrolled variables, this type of testing may not always prove to be a viable alternative.

Both substitution and strain tests make use of material or items typically weighed on the scale to apply a load to the scale in order to occupy or "use up" part of the capacity of the device. Material and error weights take the place of a known quantity when performing a substitution test, while strain testing uses material as an unknown quantity. With this portion of the weighing capacity being occupied, additional test weight may be applied to test the response of the scale within the upper range of the device.

Large capacity devices such as those described in this article are in use much more so than may be readily apparent, and the effect they may have on day-to-day transactions should not be underestimated. Those involved with the design and installation of these devices should be strongly encouraged to ensure that the devices will comply with all applicable requirements in NIST Handbook 44 including installation, use, and test requirements, and to consider

the obstacles which must be overcome when verifying the scale's accuracy after installation. It is not the intent of this article to propose a universal remedy to the difficulties encountered when testing the types of scales mentioned, but rather to note the impediments involved in testing these devices. In addition, it is necessary to acknowledge the efforts of those whose routine duties require the use of technical ingenuity along with physical skills to perform these critical evaluations.